

Forward/Backward Tracking at EIC using MAPS Detectors

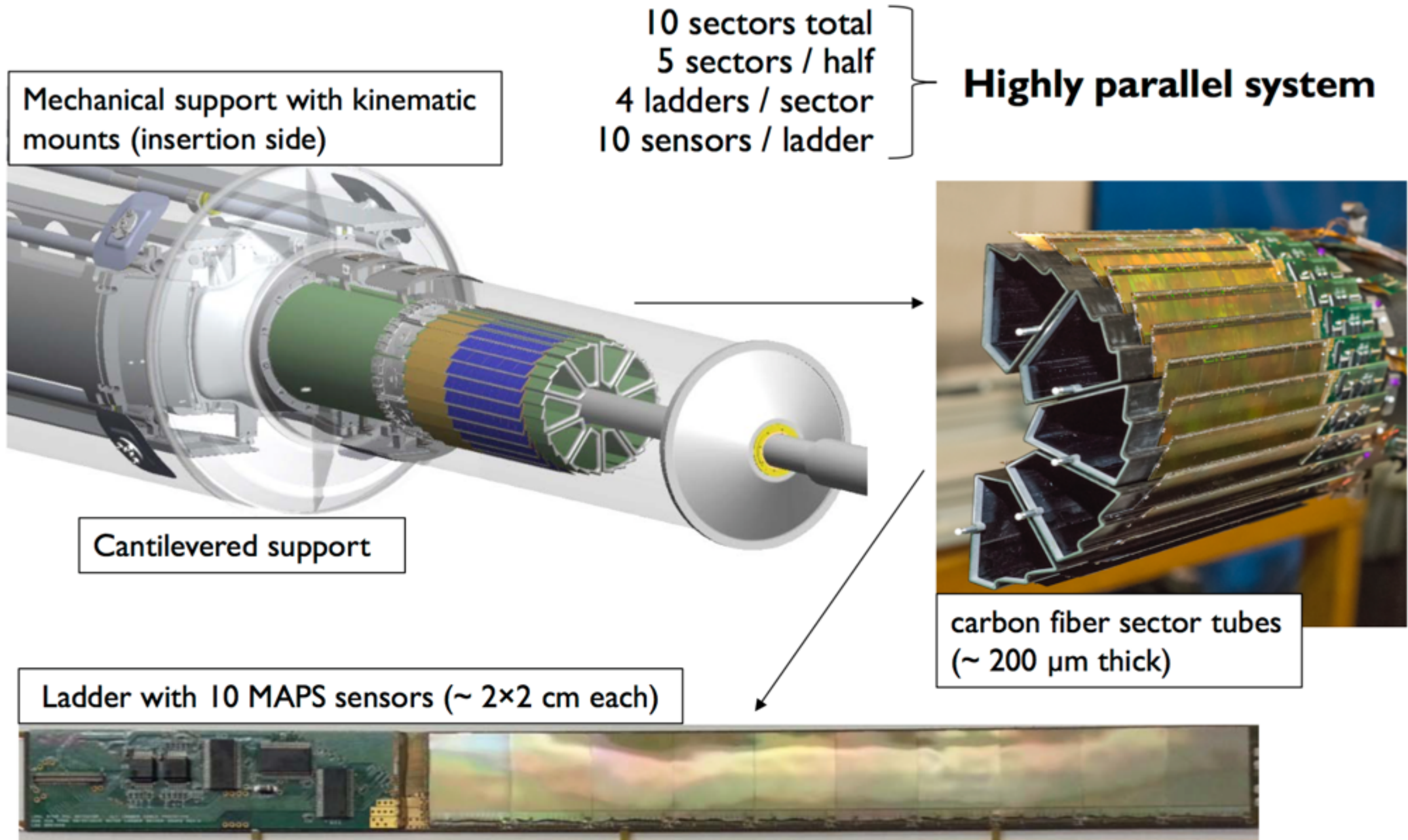
G. Contin, X. Dong, L. Greiner, B. Jacak, P. Jacobs, S. Klein, C. Loizides, G. Odyniec, M. Ploskon, A. Schmah, E. Sichtermann, J. Thomas, H. Wieman, N. Xu

Nuclear Science Division
Lawrence Berkeley National Laboratory
1 Cyclotron Road
Berkeley, Calif. 94720

Abstract:

We propose to develop a concept for a backward (electron-going direction) tracking station near the collision vertex. We focus on detection of the scattered electron, as the precision of this measurement defines the kinematics of the collision. Disks of thinned-silicon sensors (MAPS) detectors will be laid out, including conceptual design for the arrangement of services, including cooling, power, and readout. We will perform simulations to specify layout and sensors optimized for high priority early physics measurements, and eventually determine whether a copy of the same tracker should be used in the hadron-going direction. We will also perform R&D on low-mass cabling utilizing aluminum traces.

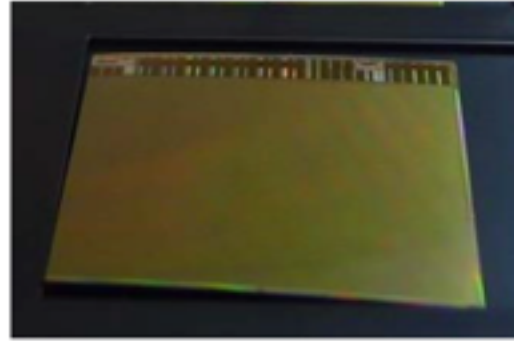
RNC - STAR HFT-PXL



RNC - STAR HFT-PXL

▶ Thinned Sensor

- ▶ 50 μm
- ▶ 0.068% X_0

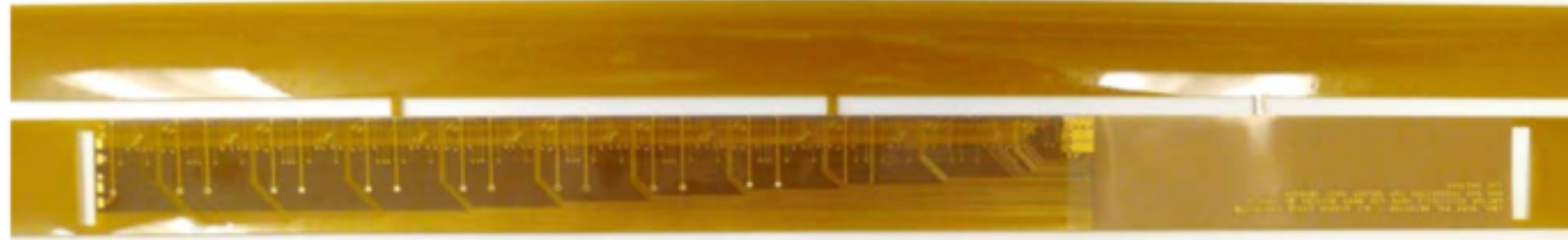


▶ Curved sensor

- ▶ 40-60% yield after thinning, dicing and probe testing

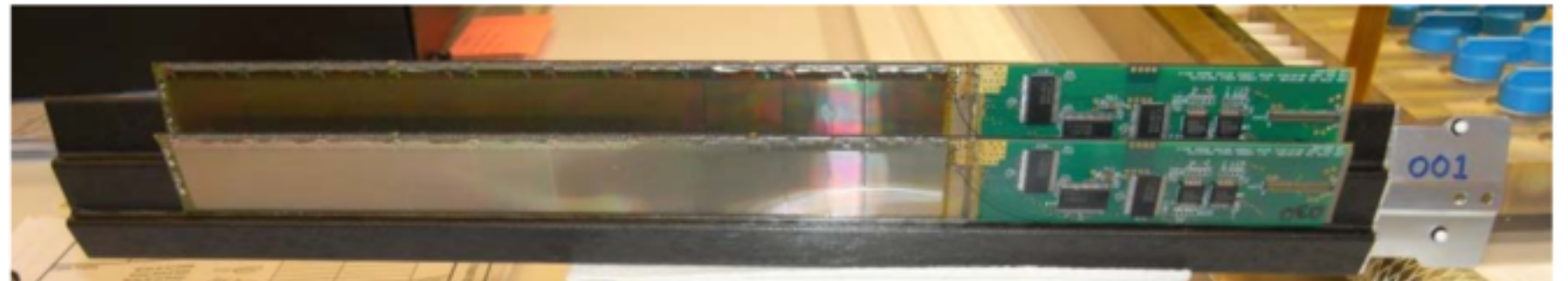
▶ Flex Cable

- ▶ Aluminum-Kapton
- ▶ two 32 μm -thick Al layers
- ▶ 0.128% X_0
 - ▶ Copper version \rightarrow 0.232% X_0



▶ Carbon fiber supports

- ▶ 125 μm stiffener
- ▶ 250 μm sector tube
- ▶ 0.193% X_0



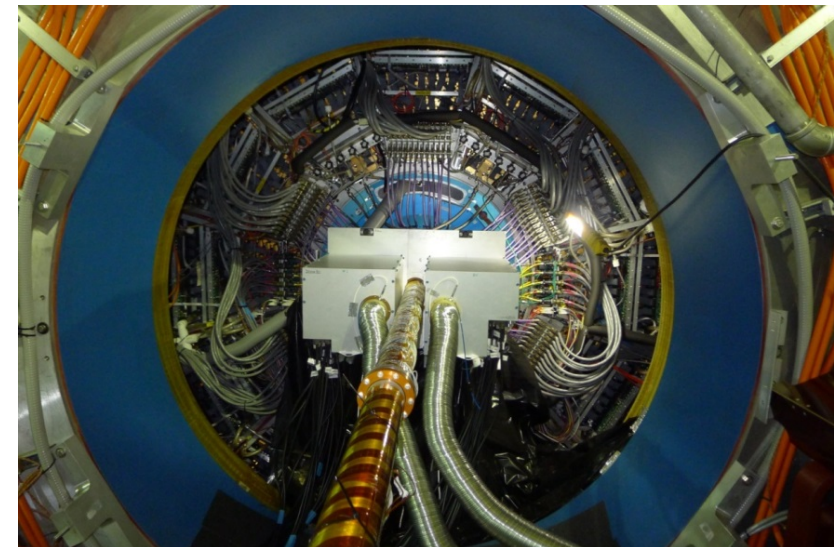
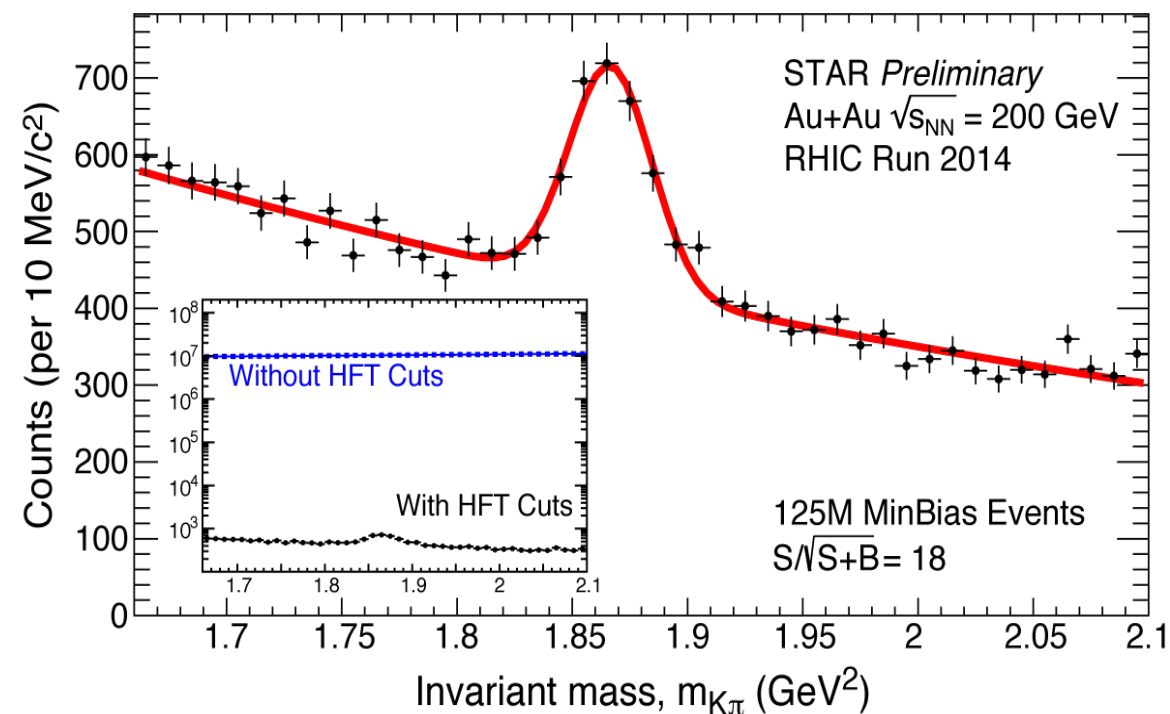
▶ Cooling

- ▶ Air cooling: negligible contribution

- ▶ **Total material budget on inner layer: 0.3888% X_0**
(0.492% X_0 for the Cu conductor version)

RNC - STAR HFT-PXL

First large scale MAPS based vertex detector at a collider experiment.



PXL inserted into STAR, cabled and working in 24 hours

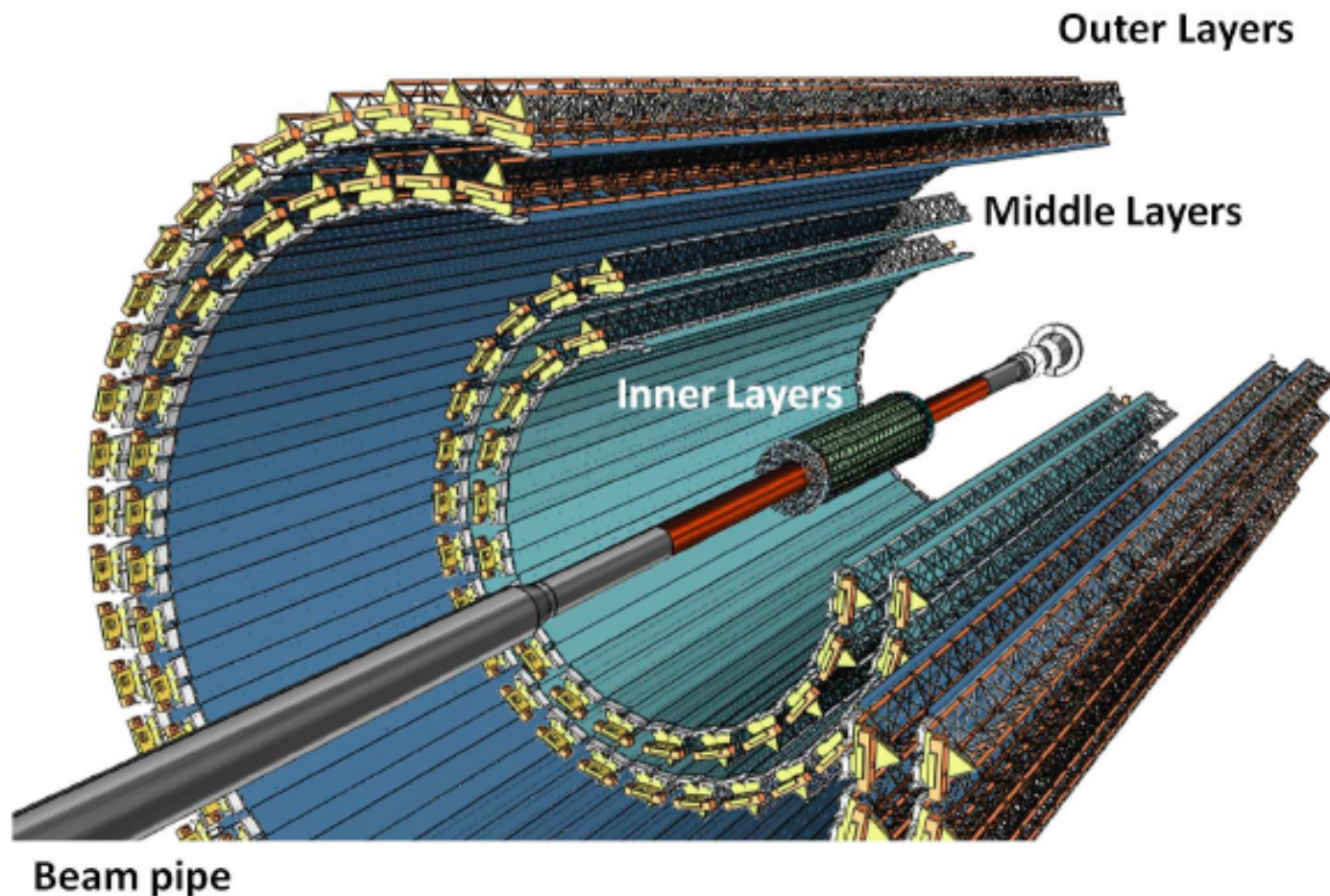
RNC scope:

Full simulation and optimization.

Full system design including R&D into MAPS sensors with IPHC
Strasbourg.

Full construction including RDO electronics, firmware, software,
commissioning and analysis.

ALICE ITS Upgrade



- 7 layers
- 10 m² of silicon
- Installation in early 2019
- $X/X_0 \sim 0.3\%$ (inner layers)
- $X/X_0 \sim 0.8\%$ (outer layers)

Anticipated use of CERN-developed MAPS sensors, ALPIDE:

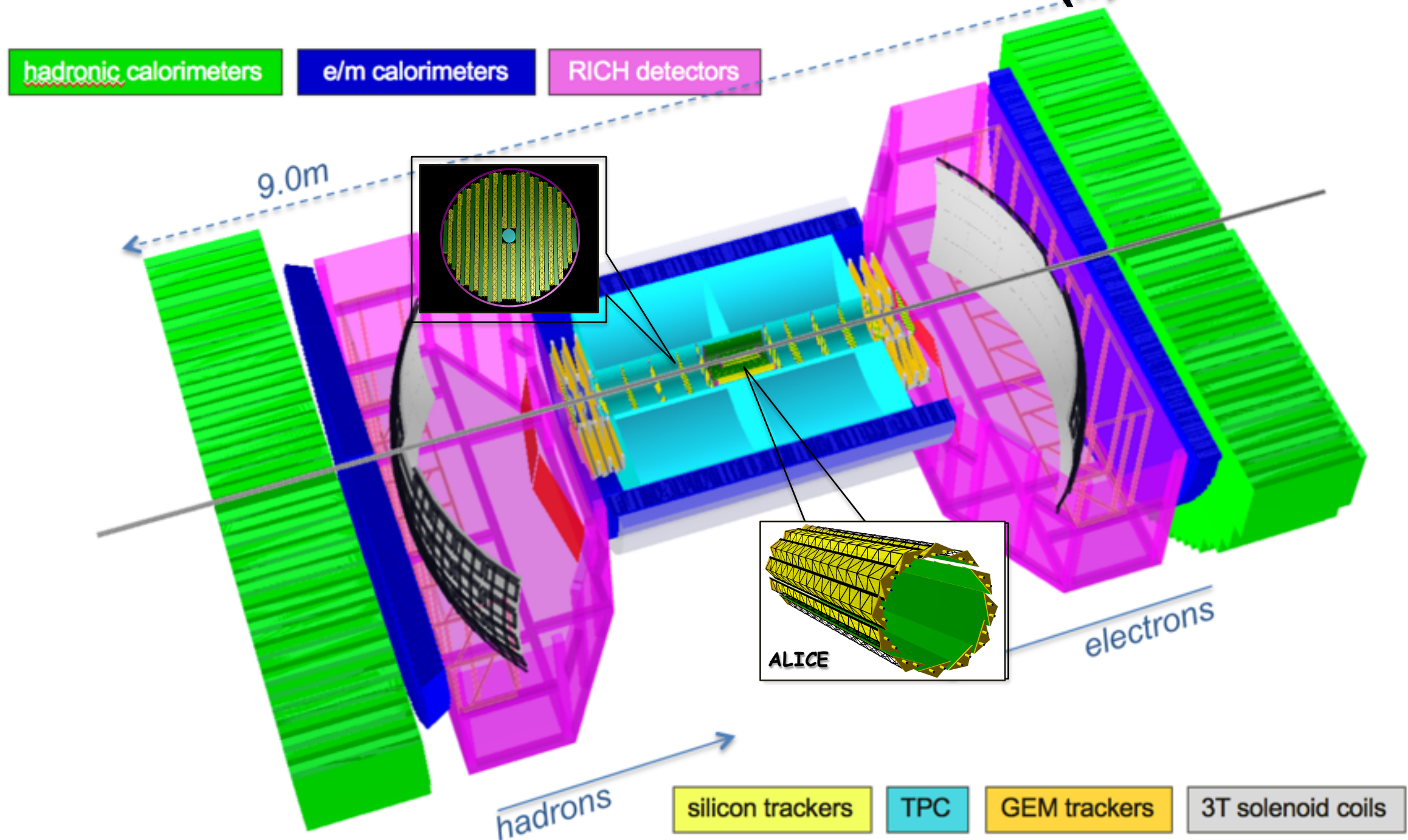
Dimensions:	15mm x 30mm
Pixel pitch:	28 μ m x 28 μ m
Integration time:	8-10 μ s
Power consumption:	39mW/cm ²

TDR: <http://iopscience.iop.org/0954-3899/41/8/087002/>

RNC scope:

middle layer staves,
readout & power,
mechanics (with LBL engineering)

eRHIC Model Detector (BeAST)



E.C. Aschenauer, A. Kiselev, et al.

MAPS-based Si; minimize bremsstrahlung, resolutions, and also vertexing.

RNC - EIC R&D proposal

- *Simulations and calculations* to quantitatively address:
 - disk configuration(s),
 - services,
 - sensor specifications and development needs, if any,
sampling rate, pixel size

Product: high-level sensor specifications and development needs
conceptual design of a forward tracker for two or more field configurations

- Iterative development of low-mass cables
 - ultimate goal is a *new* production partner for *aluminum* conductor cables,
besides CERN and Institute at Kharkov Ukraine,
 - contact with and build on prior work with the Hughes Circuits Inc,

Product: uncertain - a 'must do' for the community as a whole.

The [EIC Detector Advisory] committee strongly encourages carrying out the simulation studies leading to a design of the forward and backward tracking detectors.

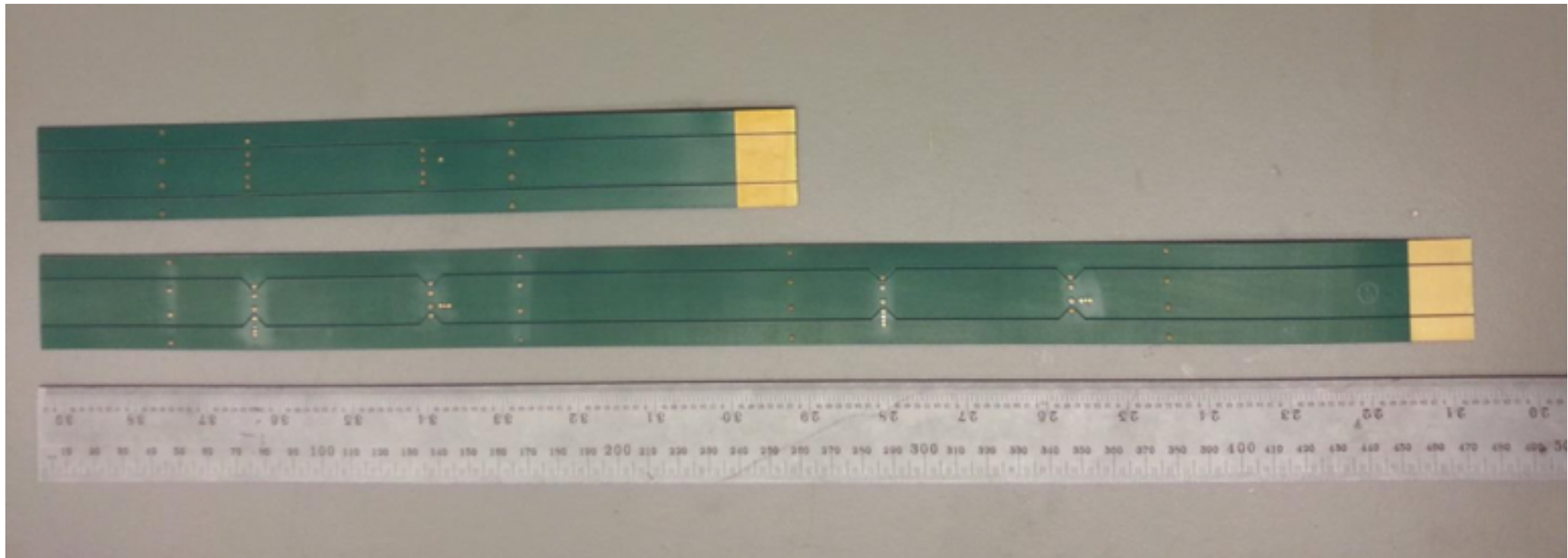
RNC - EIC R&D proposal

- *Simulations and calculations:*
 - postdoc hire late Summer did not work out,
 - partially funded, inter-lab administrative delay(s),
 - effort is yet to start in a concerted way,
- + UC-Berkeley student is joining the effort ~now,
- + developing postdoc pool following (re-)advertisement past Fall,

RNC - EIC R&D proposal

- *Iterative development of low-mass cables*

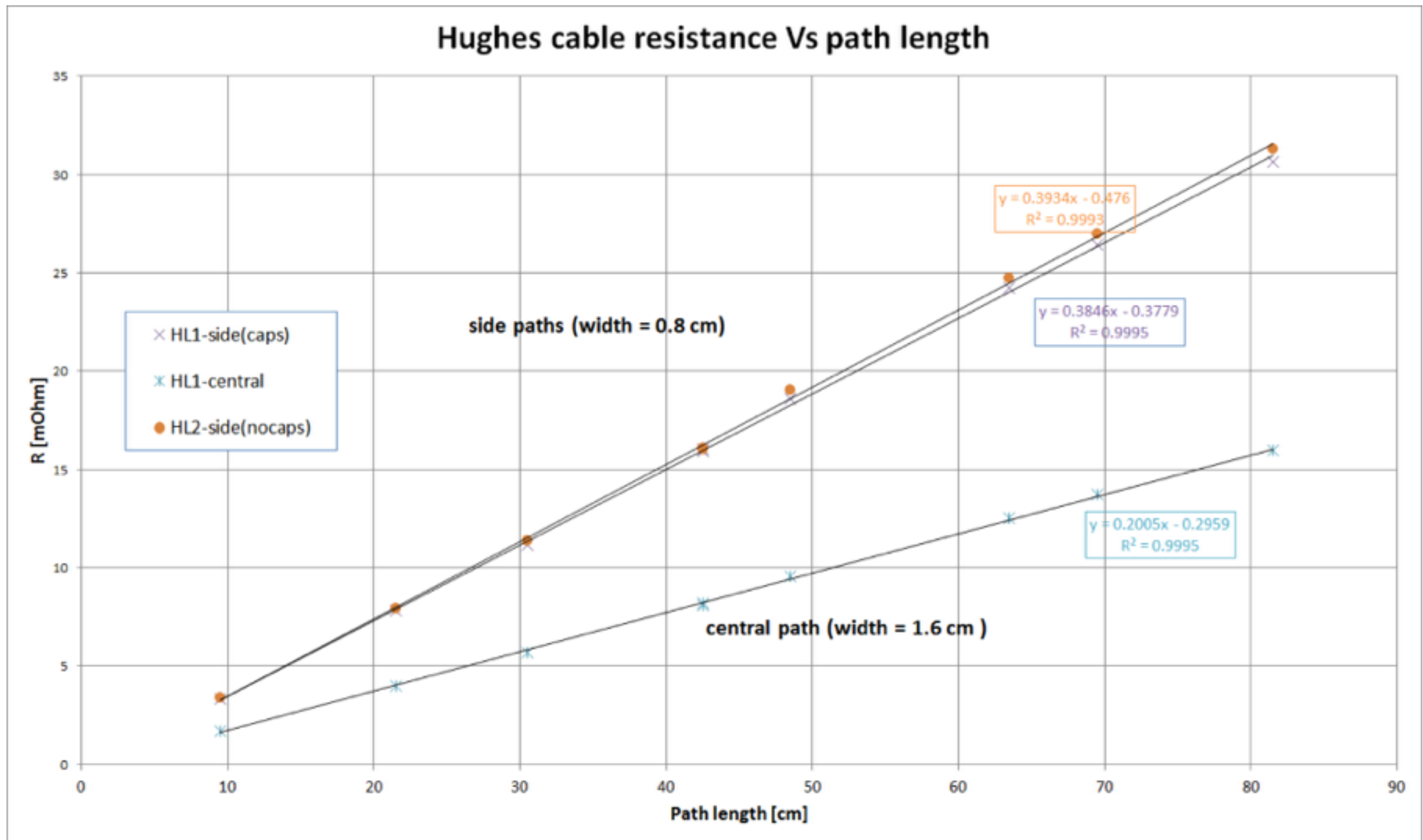
+ ~synergy with power development for the ALICE-ITS:



Hughes Circuit Inc. delivered new Al-conductor flex-cable samples,
Optically and electrically characterized; QA/yield-issue (addressable),
Al-conductor cables obtained also from the Kharkov Institute (tab-bonded),

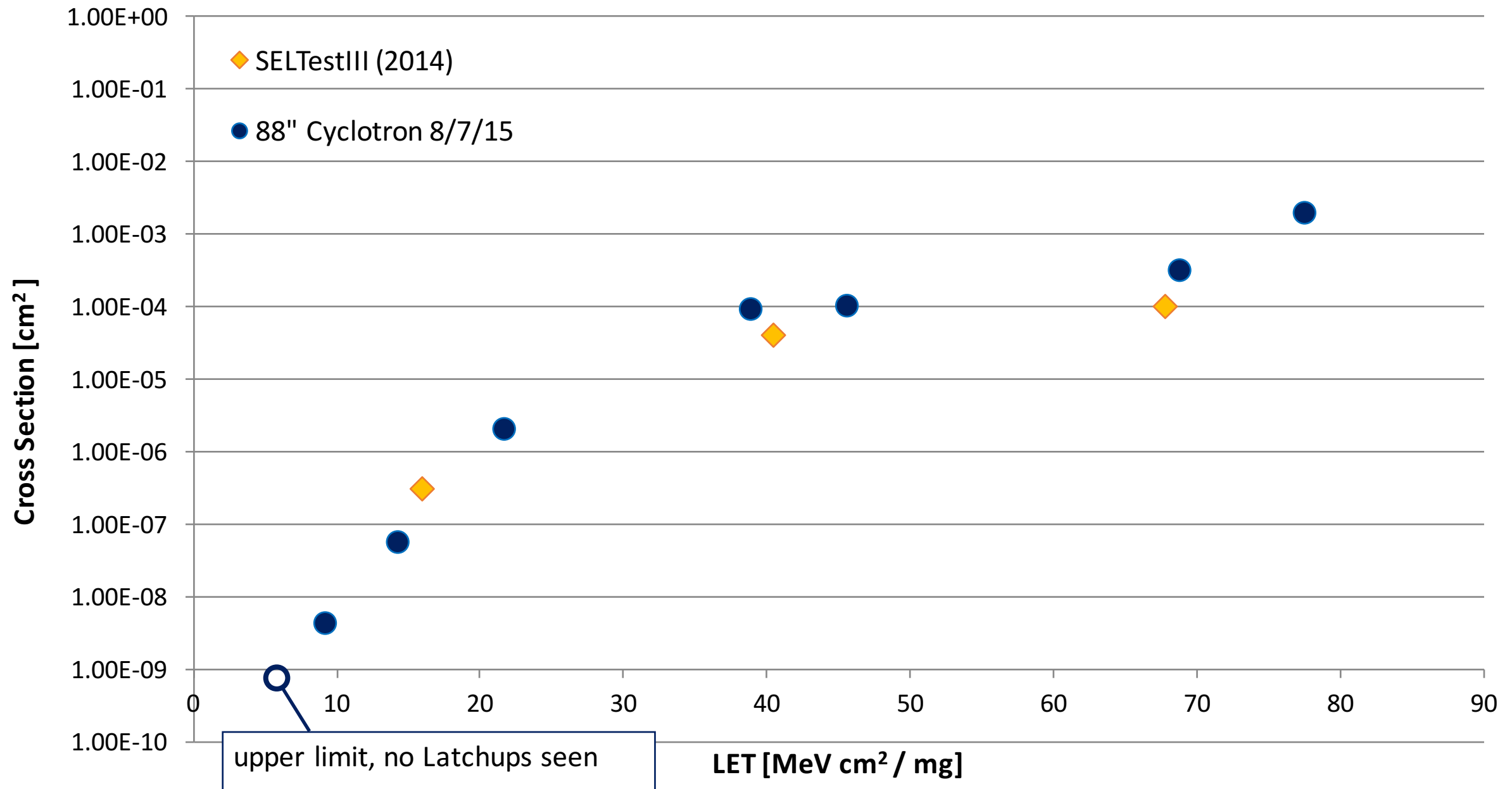
- ALICE-ITS appears to converge on Cu-conductor cables for its non-inner layers.

Hughes Circuit Inc - Al conductor flex-cable



ALPIDE-1 latch-up measurements

ALPIDE-1 Latchup Cross Sections 88" Cyclotron Run 8/7/15



Joanna Szornel, Elad Michael, Fernando Torales Acosta, Leo Greiner, Barbara Jacak
the LBNL 88" cyclotron and its staff